

## **Design Requirements**

### **Landscape Plan**

A final landscape plan is required where landscape planting or mitigation planting will occur. The landscape plan shall be submitted for Acceptance by the CDOT Project Engineer and the CDOT Landscape Architect.

An interim and final stabilization plan shall be required for any area of the work where new construction disturbance occurs, and shall be developed in conjunction with erosion control requirements as a Best Management Practice in Section 5 - Environmental.

Landscape design and re-vegetation (stabilization) plans shall include, but not limited to, the mitigation measures as described and as listed below:

- Cut and fill slopes shall be minimized and the cut line blended into the existing terrain. Maximum soil slope steepness shall be 2H:1V.
- Permanent and temporary stabilization for each construction phase.
- Areas to be permanently stabilized after completion shall follow the requirements of the 2011 CDOT Standard Specifications for Road and Bridge Construction, Sections 101, 107, and 208, 213, and 620 Water Quality Control, 213 Mulching specifications, and other referenced material.
- Disturbed areas where work has halted shall follow the requirements of the 2011 CDOT Standard Specifications for Road and Bridge Construction, Sections 101, 107, and 208, 213, and 620 Water Quality Control.
- Removal of adjacent roadside vegetation shall be minimized where possible
- Amend embankment to prepare topsoil with compost/bionutrients. Temporary erosion control and sediment control BMP's shall be maintained until the requirements of Section 5 – Environmental are satisfied.

### **Construction Requirements**

#### **Temporary Seeding and Stabilization**

Disturbed areas where work has halted shall follow the requirements of the 2011 CDOT Standard Specifications for Road and Bridge Construction, Sections 101, 107, and 208, 213 and 620 - Water Quality Control.

All temporary disturbed areas not within the work area will be returned to preconstruction elevation and contours and reseeded with the CDOT approved native seed mix that is certified weed free.

Control noxious weeds, if present prior to disturbance, as needed throughout construction and until SCP permit inactivation.

### **Clearing and Work Area Limits Identification and Protection**

- The Contractor shall delineate the clearing and work limits for Acceptance by the CDOT Project Engineer (see Section 5, Migratory Birds for bird nesting survey requirements). Existing vegetation and or sensitive environments to remain shall be identified and protected. BMP's shall be used to prevent degradation of habitats adjacent to construction area. The CDOT Project Engineer will flag those trees adjacent to the boundary that are to remain in place. If trees, shrubs and willows are within the Contractor delineated clearing and work limits the following requirements will apply:
- The Contractor shall use all appropriate care to avoid damage or removal of the flagged trees. Trees that are damaged shall be replaced at the Contractor's expense. Trees that are damaged and assessed as salvageable shall be promptly repaired, pruned, wrapped, and protected from further damage at the Contractor's expense.
- Any native tree removed with a diameter of 2 inches or greater will be replaced in-kind at a 4:1 ratio. The diameter of a tree is the measured diameter 2-feet up the tree from the ground surface.
- Shrubs and willows removed shall be replaced with live willow cuttings collected from nearby stands. Willow cuttings will be placed on 2 foot centers.
- All planted trees and shrubs located in planting areas as shown in the Plans shall be protected with geotextile fabric and wood chip mulch. Trees will not be accepted if the ball of earth surrounding the roots is cracked or broken during delivery and planting.
- The Contractor shall repair or replace in-kind all landscape material and vegetation on private property which is disturbed by the Work. Replaced materials shall be equal or better to the existing materials in size, type and condition.

### **Removal of Trees and Shrubs**

Tree stumps within the roadway prism or within 10 feet of the edges of roadway pavements shall be completely removed and disposed of off the Project site. All other tree stumps within the Project shall be ground 3 feet below finished grade.

All trees or shrubs removed from the Project shall become the property of the Contractor and be completely disposed of off-site by the Contractor.

### **Tree and Shrub Transplanting**

The Contractor shall not transplant or use non-native trees or shrubs.

The Contractor shall transplant native shrubs requiring transplanting within the Right-of-Way and outside the clear zone requirements in conformance with the Contract.

### **Pruning**

The Contractor shall have all root and branch pruning completed by a licensed and certified tree surgeon. All work shall be in accordance with American National Standard Institute – ANSI A300-1995, Section 5.3.3.2.

### **Root Pruning**

Tree roots 2 inches or greater in diameter shall not be removed, unless they interfere with the work. Extensive root pruning may require tree replacement as directed by the Engineer.

Roots below the excavation depth for the work shall not be pruned.

### **Branch Pruning**

The Contractor may prune branches that will interfere with the Work

### **Staking and Watering**

New and transplanted trees shall be staked. Stakes and guying shall comply with the CDOT Standard Plans and Specifications.

The Contractor shall water new and transplanted trees on the Project as required by the Contract.

### **Topsoil**

The Contractor shall prepare topsoil with organic amendments at a rate of 43 cubic yards/acre, as described in subsection 212.02 (b) of the 2011 CDOT Standard Specifications for Road and Bridge Construction. The prepared topsoil shall be spread over all disturbed areas with a minimum thickness of 4 inches. The prepared topsoil shall not include any minerals or elements detrimental to plant growth. All rocks and debris larger than 4 inches in diameter that are visible after the topsoil is prepared and spread shall be removed and disposed of in an appropriate manner off the project site.

### **Permanent Native Seeding**

Placement of soil conditioning and fertilizer, seeding and mulching shall not be done in

a single operation, and shall be completed within 48 hours following each construction phase or prior to any winter shutdown work. All seeding requirements in the approved project SWMP shall also be followed. Fertilizer shall not be used adjacent to wetlands and waterways. Refer to the Standard Specification Section 212 for additional requirements.

All disturbed areas within the Right-of-Way which are not surfaced shall be re-vegetated to replicate or enhance native vegetative communities. Re-vegetation species that attract wildlife to the Highway or practices that allow noxious weeds shall not be used.

Due to high failure rates the Contractor will not be allowed to use hydromulching and/or hydroseeding or straw.

Seeding shall be drilled 1/4-inch to 1/2-inch into the soil. In areas where machine seeding is impossible, hand broadcast at double the contract rate, and rake 0.25 inch to 0.5 inch into the soil.

Mulch tackifier shall be applied at a rate of 200 pounds per acre.

Mulching application shall be 1.5 tons of certified weed free hay per acre mechanically crimped into the soil in combination with organic mulch tackifier.

The soil conditioning and fertilizer requirements shall be 800 pounds per acre biological nutrient (organic material based fertilizer) (Biosol, Sustane, or Grow Power) and 600 pounds per acre humate.

All native seeding areas with slopes 3:1 or flatter shall be mulched and mechanically crimped with 1.5 tons per acre of weed free hay and applied with mulch tackifier.

All other slopes shall have soil retention blanket for slopes steeper than 3:1. Roadside ditches shall be lined with soil retention blanket or turf reinforcement blanket to contain the design flow width (wetted perimeter), designed based on the hydraulics of the ditch for both before and after the final stabilization is established. If soil retention blanket is used, mulch and tackifier are not required.

### **Reseeding Operations and Corrective Stabilization**

Prior to final acceptance

1. Seeded areas shall be reviewed during the 14 day inspections by the Erosion Control Supervisor for bare soils caused by surface or wind erosion. Bare areas caused by surface or gully erosion, blown away mulch, etc. shall be re-graded, seeded, mulched and have mulch tackifier (or blanket) applied as necessary.

2. The Contractor shall maintain seeding/mulch/tackifier, mow to control weeds or apply herbicide to control weeds in the seeded areas until Final Acceptance.

The Contractor shall use the following seed mixes for locations within the Project:

**INTERIM AND FINAL STABILIZATON**

A. SEEDING PLAN

Soil preparation, Soil Conditioning, Topsoil, Seeding (Native), Soil Retention Blanket and Mulching will be required for an estimated xxx acres of disturbed area within the right-of-way limits which are not surfaced. The following types and rates shall be used:

<i>COMMON NAME</i>	<i>BOTANICAL NAME</i>	<i>POUNDS PLS/ACRE</i>
Blue grama	Bouteloua gracilis v. Hachita	2
Western wheatgrass	Pascopyrum smithii v arriba	6
Sideoats grama	Bouteloua curtipendula v. Vaughn	3
Little bluestem	Schizachyrium scoparium 'Pastura'	3
Green needlegrass	Stipa viridula v. Lordom	3
Switchgrass	Panicum virgatum 'Dacotah"	4
Junegrass	Koeleria macrantha	0.2
Hilaria jamesii	Galleta Grass 'Viva'	5
Sand dropseed	Sporobolus cryptandrus	0.1
Inland Saltgrass	Distichlis spicata stricta	1
Coneflower	Ratibida columnaris	0.5
Gaillardia	Gaillardia aristata	1
Oats	Avena sativa	3
<b>TOTAL</b>		<b>31.8</b>

**Noxious Weed Management Plan**

Identify and provide a noxious weed management plan if state noxious weeds are present.

The Contractor shall use CDOT's standard protocol for weed management, including

the development of an Integrated Noxious Weed Management Plan (INWMP) to mitigate the potential adverse effects of earth disturbance.

**Deliverables**

At a minimum, the Contractor shall submit the following to CDOT for review, Approval and/or Acceptance:

<b>Deliverable</b>	<b>Acceptance or Approval</b>	<b>Schedule</b>
Final Landscape Plan	Acceptance	Prior to Landscaping
Seed Certification and Fertilizer Analysis	Acceptance	Prior to placing
Noxious Weed Management Plan	Acceptance	Prior to disturbance
Organic Soil Amendment Certificate of Compliance	Acceptance	At least 30 Days prior to its use on the Project
Organic Soil Amendment Compost CDPHE facility permit to produce or sell compost	Acceptance	Prior to application
Organic Soil Amendment Compost U.S. Composting Council’s Seal of Testing Assurance Program (STA) participation certificate and test data on a Compost Technical Data Sheet	Acceptance	Prior to application

---

---

## PROJECT SPECIAL PROVISIONS

### REVISION OF SECTION 216 SOIL RETENTION COVERING

Section 216 of the Standard Specifications is hereby deleted for this project and replaced with the following:

#### DESCRIPTION

**216.01** This work consists of furnishing, preparing, applying, placing, and securing soil retention blankets and turf reinforcement mats for erosion control on roadway ditches, slopes, or channels as designated in the Contract or as directed.

#### MATERIALS

**216.02** Soil retention covering shall be either a soil retention blanket or a turf reinforcement mat as specified in the Contract. It shall be one of the products listed on CDOT's Approved Products List and shall conform to the following:

- (a) *Soil Retention Blanket.* Soil retention blanket shall be composed of degradable natural fibers mechanically bound together between two slowly degrading synthetic or natural fiber nettings to form a continuous matrix. The blanket shall be of consistent thickness with the fiber evenly distributed over the entire area of the mat.

When biodegradable blanket is specified, the thread shall be 100 percent biodegradable; polypropylene thread is not allowed.

When photodegradable netting is specified the thread shall be polyester, biodegradable or photodegradable.

Blankets and nettings shall be non-toxic to vegetation and shall not inhibit germination of seed. The materials shall not be toxic or injurious to humans. Class 1 blanket shall be an extended term blanket with a typical 24 month functional longevity. Class 2 blanket shall be a long term blanket with a typical 36 month functional longevity. The class of blanket is defined by the physical and performance characteristics.

1. *Soil Retention Blanket (Straw-Coconut).* Soil Retention Blanket (Straw-Coconut) shall be a machine produced mat consisting of 70 percent agricultural straw and 30 percent coconut fiber. It shall be either biodegradable or photodegradable. When specified lightweight polypropylene netting shall be 1.5 pounds per 1000 square feet; heavyweight netting shall be 2.9 pounds per 1000 square feet. Blankets shall be sewn together on 1.50 inch to 2 inch centers.

Netting shall be as follows:

When biodegradable netting is specified, the top and bottom netting shall be 100 percent biodegradable organic jute fiber. Netting shall be constructed using a Leno weave which allows the strands of the net to move independently of each other.

When photodegradable netting is specified, the bottom side shall be lightweight polypropylene. The top side shall be heavyweight or lightweight polypropylene.

2. *Soil Retention Blanket (Excelsior)*. Soil retention blanket (excelsior) blanket shall consist of a machine produced mat of 100% curled wood excelsior with 80 percent, 6 inch or longer fiber length. It shall be either biodegradable or photodegradable. When specified lightweight polypropylene netting shall be on both sides of the blanket and shall be 1.5 pounds per 1000 square feet. Blankets shall be sewn together at a maximum of 4 inch centers.

Netting shall be as follows:

When biodegradable netting is specified, the top and bottom netting shall be 100 percent biodegradable organic jute fiber. Netting shall be constructed using a Leno weave which allows the strands of the net to move independently of each other.

When photodegradable netting is specified, the bottom side shall be lightweight polypropylene. The top side shall be heavyweight or lightweight polypropylene.

3. *Soil Retention Blanket (Coconut)*. Soil Retention Blanket (Coconut) shall be a machine produced mat consisting of 100 percent coconut fiber. It shall be either biodegradable or photodegradable.

Netting shall be as follows:

When biodegradable netting is specified, the top and bottom netting shall be 100 percent biodegradable organic jute fiber. Netting shall be constructed using a Leno weave which allows the strands of the net to move independently of each other.

When photodegradable netting is specified, the bottom and top side shall be heavyweight polypropylene.

**Table 216-1  
 PHYSICAL REQUIREMENTS FOR SOIL RETENTION BLANKET –  
 PHOTODEGRADABLE OR BIODEGRADABLE BLANKETS**

Product Class	Minimum Roll Width	Minimum Thickness ASTM D 6525	Acceptable Matrix Fill Material	Min. Mass per Unit Area ASTM D 6475	Size of Net Opening	
					Photo-degradable	Bio-degradable
1	6.5'	0.25"	Straw/Coconut	8 oz/sy	Minimum: 0.50"x0.50" Maximum: 0.75"x0.75"	Minimum: 0.50"x0.50" Maximum: 0.5"x1.0"
1	6.5'	0.25"	Excelsior	8 oz/sy	Minimum: 0.50"x0.50" Maximum: 1.0"x2.0"	NONE

2	6.5'	0.20"	Coconut Fibers	8oz/sy	Minimum: 0.50" x0.5" Maximum: 0.75"x0.75"	Minimum: 0.50"x0.50" Maximum: 0.5"x1.0"
---	------	-------	-------------------	--------	--	--

**Table 216-2  
 PERFORMANCE REQUIREMENTS FOR SOIL RETENTION BLANKET –  
 PHOTODEGRADABLE OR BIODEGRADABLE BLANKETS**

Product Class	Slope Application "C" Factor <sup>1</sup> ASTM D 6459	Channel Application Permissible Shear Stress <sup>2</sup> (Un-vegetated) ASTM D 6460	Minimum Tensile Strength ASTM D 6818
1	≤ 0.10@3:1	2.00 lbs/sf	100 lbs/ft
2	≤ 0.10@3:1	2.25 lbs/sf	125 lbs/ft

Notes:

<sup>1</sup> "C" Factor calculated as ratio of soil loss from soil retention blanket protected slope (tested at specified or greater gradient, h:v) to ratio of soil loss from unprotected (control) plot in large-scale testing.

<sup>2</sup> Permissible shear stress is the minimum shear stress that a product must be able to sustain without physical damage or excess soil loss when it is installed on a bare soil channel. Failure is defined as ½ inch of soil loss during a 30 minute flow event in large scale testing.

Blankets shall be tested for physical properties and have published data from a pre-approved independent testing facility.

Large scale testing of Permissible Shear Stress and Slope Erosion Protection ("C" factor) shall be performed by a pre-approved independent testing facility.

A sample of the staples and a copy of the manufacturer's product data showing that the product meets the Contract requirements shall be submitted for approval at the environmental preconstruction conference.

- (b) *Turf Reinforcement Mat.* Turf reinforcement mat (TRM) shall be a rolled mat consisting of UV stabilized, corrosion resistant, non-degradable synthetic fibers, filaments, or nets processed into a permanent three-dimensional matrix of the thickness specified in Table 216-3. TRMs shall provide sufficient thickness, strength and void space to permit soil filling and retention and the development of vegetation within the matrix. When TRM is not soil filled, the mat shall be tan in color. The class of TRM is defined by the physical and performance characteristics.

**Table 216-3  
 PHYSICAL REQUIREMENTS<sup>1</sup> FOR TURF REINFORCEMENT MAT**

Product Class	Minimum Roll Width	Minimum Thickness ASTM D 6525	Acceptable Matrix Fill Material <sup>2</sup>	Size of Net Opening <sup>2</sup>
1	6.5'	0.25"	Excelsior, Straw/Coconut, Coconut, or Polymer fibers	Minimum: 0.50"x0.50" Maximum: 0.75"x0.75"
2	6.5'	0.25"	100% UV Stabilized Synthetic Fibers	0.50"x 0.50"
3	6.5'	0.25"	100% UV Stabilized Synthetic Fibers	0.50"x 0.50"

**Notes:**

<sup>1</sup> For TRMs containing degradable components, all property values shall be obtained on the non-degradable portion of the matting alone.

<sup>2</sup> For TRMs with nets and fill material. Netted TRMs shall be sewn together on 1.5 inch to 2 inch centers.

**Table 216-4  
 PERFORMANCE REQUIREMENTS FOR TURF REINFORCEMENT MAT**

Product Class	Tensile Strength MD ASTM D 6818	UV Stability @ 500 Hours ASTM D 4355	Maximum Permissible Shear Stress <sup>1</sup> (Vegetated) ASTM D 6460
1	125 lbs/ft	80%	6.0 lbs/sf
2	150 lbs/ft	80%	8.0 lbs/sf
3	175 lbs/ft	80%	10.0 lbs/sf

**Notes:**

<sup>1</sup> Permissible shear stress is the minimum shear stress that a product must be able to sustain when placed on a fully vegetated channel without physical damage or excess soil loss. Failure is defined as ½ inch of soil loss during a 30 minute flow event in large scale testing.

TRMs shall be tested for physical properties and have published data from a pre-approved independent testing facility.

Large scale testing of Permissible Shear Stress will be performed by a pre-approved independent testing facility.

A sample of the staples and a copy of the manufacturer's product data showing that the product meets the Contract requirements shall be submitted for approval at the environmental preconstruction conference.

(c) *Staples*. Staples shall be made of wire:

For use in Channel: 0.165 inch, “U” shaped staples shall be 8 inches long and have a 1 inch crown.

For use on Slope: 0.165 inch, “U” shaped staples shall be 8 inches long and have a 1 inch crown.

“T” shaped pins shall not be used.

### CONSTRUCTION REQUIREMENTS

**216.03** The Contractor shall install soil retention coverings using the following procedure:

- (1) Prepare a stable and firm soil surface free of rocks, weeds, clods, roots, sticks, rivulets, gullies, and other obstructions.
- (2) Apply topsoil or soil conditioning as directed in the Contract to prepare seed bed.
- (3) Place seed in accordance with the Contract.
- (4) Unroll the covering parallel to the primary direction of flow.
- (5) Ensure that the covering maintains direct contact with the soil surface over the entirety of the installation area.
- (6) Do not stretch the material or allow it to bridge over surface inconsistencies.
- (7) Staple the covering to the soil such that each staple is flush with the underlying soil.
- (8) Ensure that staples are installed full depth to resist pull out. No bent over staples will be allowed. Install anchor trenches, seams, and terminal ends as shown on the plans.

If filling a TRM with soil, the Contractor shall:

- (1) Place 3 inches of topsoil or soil amended with soil conditioning.
- (2) Apply seed and rake into soil.
- (3) Install TRM
- (4) Place 0.5 inch to 1 inch of topsoil or soil amended with soil conditioning into the matrix to fill the product thickness.
- (5) Apply seed and rake into soil.
- (6) Install soil retention blanket (Class 1) over the seeded area and TRM.

When applicable, the covering shall be unrolled with the heavyweight polypropylene netting on top and the lightweight polypropylene netting shall be in contact with the soil.

**216.04 Slope Application.** Soil retention coverings shall be installed on slopes as follows:

The upslope end shall be buried in a trench 3 feet beyond the crest of the slope. When specified by the manufacturer, trench depth shall be increased up to 12 inches in depth. Before backfilling begins, staples shall be placed across the width of the trench. The trench shall then be backfilled to grade with soil amended with soil conditioning or topsoil, compacted by foot tamping, and seeded. Fabric shall be brought back over trench and stapled at 1 foot on center.

There shall be an overlap wherever one roll of fabric ends and another begins with the uphill covering placed on top of the downhill covering. Staples shall be installed in the overlap.

---

There shall be an overlap wherever two widths of covering are applied side by side. Staples shall be installed in the overlap.

Staple checks shall be applied on the slope every 35 feet. Each staple check shall consist of two rows of staggered staples.

The down slope end shall be buried in a trench 3 feet beyond the toe of slope. Before backfilling begins, staples shall be placed across the width of the trench. The trench shall then be backfilled to grade with soil amended with soil conditioning or topsoil, compacted by foot tamping, and seeded. Fabric shall be brought back over trench and stapled. If a slope runs into a receiving water or cannot be extended 3 feet beyond the toe of slope, the end of covering shall be secured using a staple check as described above.

Coverings shall be securely fastened to the soil by installing staples at the minimum rate shown on the plans. Staple spacing shall be reduced where required due to soil type or steepness of slope.

**216.05 Channel Application.** Soil retention coverings shall be installed as follows on a channel application:

Coverings shall be anchored at the beginning and end of the channel across its entire width by burying the end in a trench. When specified by the manufacturer, trench depth shall be increased up to 12 inches in depth. Before backfilling begins, staples shall be placed across the width of the trench. The trench shall then be backfilled to grade with soil amended with soil conditioning or topsoil and compacted by foot tamping, and seeded. Fabric shall be brought back over the trench and stapled.

Covering shall be unrolled in the direction of flow and placed in the bottom of the channel first. Seams shall not be placed down the center of the channel bottom or in areas of concentrated flows when placing rolls side by side.

There shall be an overlap wherever one roll of covering ends and another begins with the upstream covering placed on top of the downstream covering. Two rows of staggered staples shall be placed.

There shall be an overlap wherever two widths of covering are applied side by side. Staples shall be placed in the overlap.

The covering shall be anchored every 30 feet with a check slot. Check slots shall extend the entire width of the channel. The covering shall be buried in a trench. Before backfilling begins, staples shall be placed across the width of the trench. The trench shall then be backfilled to grade with soil amended with soil conditioning or topsoil, compacted by foot tamping, and seeded. Fabric shall be brought back over trench and continued down the channel.

Coverings shall be securely fastened to the soil by installing staples at the minimum rate shown on the plans. Staple spacing shall be reduced where needed due to soil type or high flows.

**216.06 Maintenance.** The Contractor shall maintain the soil retention coverings until all work on the Contract has been completed and accepted. Maintenance shall consist of the repair of areas where damage is due to the Contractor's operations. Maintenance shall be performed at the Contractor's expense. Repair of those areas damaged by causes not attributable to the Contractor's operations shall be repaired by the Contractor and will be paid for at the contract

unit price. Areas shall be repaired to reestablish the condition and grade of the soil and seeding prior to application of the covering.

**METHOD OF MEASUREMENT**

**216.07** Soil retention coverings, including staples, complete in place and accepted, will be measured by the square yard of finished surface. Allowance will not be made for overlap.

**BASIS OF PAYMENT**

**216.08** The accepted quantities of soil retention coverings will be paid for at the contract unit price per square yard.

Payment will be made under:

**Pay Item Pay Unit**

Soil Retention Blanket (\_\_\_\_) (Photodegradable Class \_) Square Yard

Soil Retention Blanket (\_\_\_\_) (Biodegradable Class \_) Square Yard

Turf Reinforcement Mat (Class \_) Square Yard

Preparation of seedbed, fertilizing, and seeding will be measured and paid for in accordance with Section 212.

When soil filled TRM is required, each TRM and its associated blanket will be measured and paid for separately. Placing and preparation of seedbed, fertilizing, and seeding of soil under the TRM layer will be measured and paid for in accordance with Section 212. Topsoil or amended soil and seed placed on the TRM will be measured and paid for in accordance with Section 207 and 212